CONSTRAINTS ON SOLAR FLARE PARTICLE TRANSPORT MODELS FROM ANISOTROPY OBSERVATIONS AT VOYAGER 1

D.C. Hamilton, G.M. Mason and G. Gloeckler

Department of Physics & Astronomy
University of Maryland, College Park, MD 20742 USA

ABSTRACT

In general a particle transport model for energetic solar flare particles contains a number of free parameters which are determined by fitting various features of observed particle events. Frequently the parameter values are not uniquely determined. In order to place tighter constraints on the models, we have examined the anisotropy of 1 and 25 MeV/nuc protons and helium nuclei during the 22 November 1977 solar particle event using data from the LECP experiment on Voyager 1 at 1.6 AU. We have combined these observations with the time-intensity profiles at Voyager 1 and at 1 AU from ISEE-1 and IMP-8 to determine the magnitude and radial dependence of the interplanetary diffusion coefficient and the required injection duration at the sun. The first order anisotropy amplitudes for both 1 MeV and 25 MeV protons are observed to decrease from maximum values (~1) during event onset at Voyager 1 to values consistent with convection in the solar wind at about 3 days into the event decay phase. The intensity and anisotropy profiles at 1.6 AU are consistent with predictions of diffusive transport with a modest mean free path ($\lambda \sim 0.1$ AU). The radial dependence of K_r which was determined for low energy particles by Mason et al. (1) from the times-to-maximum intensity of 1 MeV/nuc helium at 1 AU and 1.6 AU ($K_r = K_o r^{1.3}$) predicts too rapid an intensity decay for the 25 MeV protons at 1.6 AU. We are required to abandon a simple power law radial dependence for K_r in order to fit all the ISEE and Voyager observations.

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Reference

1. Mason, G.M. et al. 1985, 19th ICRC, La Jolla, paper SH3.2-5.